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**AIR BAG TETHER SYSTEM
COMPRISING MULTIPLE SEGMENTS CUT IN ALIGNMENT
WITH FABRIC WARP OR FILL**

5 TECHNICAL FIELD

This disclosure relates to air bag tethers and to a pattern-wise arrangement of tether components in relation to air bag panels on a fabric blank, thus resulting in increased fabric utilization and an overall cost savings per finished air bag. The air bag tether system as described herein is comprised of two congruent multi-segment tether panels

10 that are joined to one another and to a respective air bag panel. Unlike conventional tether systems, the segments that comprise the tether panels are cut in alignment with the warp and the fill of the fabric blank. This multi-segment construction, with its segments cut along the primary load-bearing axis of the fabric, decreases the amount of fabric that is used in the manufacture of the air bag and tethers, while providing sufficient 15 elongation for the tether system to be functional.

BACKGROUND

Traditionally, air bag tethers have been used to control the excursion of an air bag as it inflates. As gas is released, causing the air bag to rapidly inflate, it is necessary to keep 20 such inflation from occurring in an uncontrolled manner. Tethers, which are sewn to the front and rear panels of an air bag, keep the inflating air bag from expanding so rapidly as to adversely affect the safety of the vehicle occupant, as the vehicle occupant contacts the air bag.

25 Tethers are conventionally strip-shaped pieces of fabric that are aligned in pattern-wise arrangement on a fabric blank, or that are aligned in relation to air bag panels that may

be cut from the same blank. The patterns for these tethers may include a circular portion in the center area of the tether strip around which the strip is attached to the air bag panel. This circular portion makes it difficult to efficiently nest a number of tethers with one another on a fabric blank.

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It is understood in the industry that such tethers should have a capacity for elongation (that is, the tethers should be able to stretch to accommodate the rapid excursion of the bag). For this reason, conventional tethers have been cut on the bias with respect to the warp and fill of the fabric. However, aligning the tether patterns to meet the criterion of bias-cutting increases the amount of fabric needed to create an appropriate number of tethers for a plurality of air bags. Furthermore, because fabric utilization comprises more than fifty percent of the costs of a finished air bag, aligning the tethers in this manner increases production costs.

10 15 **SUMMARY**

The present air bag tether system addresses the problems of fabric utilization and tether elongation. Instead of the tether panels being cut on the bias, the tether panels are cut in alignment with the primary load-bearing axis of the fabric (i.e., the warp or the fill). Using a multi-segment tether system in which none of the tether panels are cut on the bias increases fabric utilization by allowing the tether segments to be arranged around air bag panels into spaces that would otherwise be considered fabric waste. The utilization of alignment-cut tether segments leads to improved fabric utilization, while providing a tether system that is capable of sustaining the forces exerted by the inflating air bag.

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BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 shows a side view of an air bag comprised of a front bag panel and a rear bag panel;

5 **FIGURE 2** shows a cross-sectional view of the air bag of **FIG. 1**, revealing a tether system incorporated therein;

FIGURE 3A shows a plan view of one tether segment of the present invention that is cut in alignment with the warp and fill of a fabric blank;

10 **FIGURE 3B** shows a plan view of a circular reinforcement as may be included in the air bag tether system of the present invention;

15 **FIGURE 3C** shows a plan view of a multi-segment tether panel, as comprised of two of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**, which would be attached to both the face and rear bag panels of the air bag of **FIG. 1**;

20 **FIGURE 3D** shows a plan view of a multi-segment tether, in which two of the tether segments of **FIG. 3A** are attached to either the face or rear panel of an air bag by a circular seam, but without the inclusion of the circular reinforcement of **FIG. 3B**;

FIGURE 4 shows a plan view of a multi-segment tether that is comprised of three of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**;

25 **FIGURE 5** shows a plan view of a multi-segment tether that is comprised of four of the tether segments of **FIG. 3A** and the circular reinforcement of **FIG. 3B**; and

FIGURE 6 shows a plan view of the arrangement of air bag panel components and the tether components of **FIGS. 3A** and **3B** on a fabric blank, in accordance with the teachings herein.

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DETAILED DESCRIPTION

In order to describe the invention, it is necessary that certain terms be defined. The term "bias" is intended to refer to a cut diagonally across the weave of a fabric, usually at an angle of 25 to 65 degrees with respect to the warp and fill. The term "substantial alignment" shall be used to describe a cut made at an angle less than 25 degrees from the warp or fill of the fabric, and, more preferably, in direct alignment with the warp or fill of the fabric.

The term "tether segment" is used to describe a unit of fabric having a length greater than its width, and, more preferably, a substantially rectangular piece of fabric, that is used in the creation of a tether panel. For simplicity, a rectangle will be used in the drawings to represent these segments. The present invention relates to tether segments that are cut in substantially alignment with either the warp or fill of the fabric. The term "tether panel" shall refer to one of two components of a tether system; each of the tether panels is comprised of two or more tether segments positioned on the same bag panel, either with or without a central reinforcement, as will be described herein. The term "tether system" shall refer to joined tether panels utilized to prevent the uncontrolled excursion of an inflating air bag from adversely affecting a vehicle occupant with whom such a bag comes into contact. Tether systems generally employ two tether panels for each finished air bag, and, as shall be described herein, each tether panel of the present invention comprises two to four tether segments.

The term "front" shall refer to that portion of an air bag that is nearest a vehicle occupant, while the term "rear" shall refer to those portions of an air bag that are furthest from the vehicle occupant (e.g., in the case of front-seat air bags, nearest the windshield). The 5 term "bag panel" shall be used to describe one of the fabric panels used to create a finished air bag. The term "central attachment region" shall refer to that area of the bag panel around which the tether segments are radially positioned. The axis of radial symmetry of the inflated air bag is located within the central attachment region.

10 Because of the speed with which an air bag inflates, it is necessary for the protection of vehicle occupants to control the volume of space that the air bag occupies in the vehicle cabin. Tethers accomplish this task by preventing the uncontrolled expansion of the air bag. Tethers are securely connected to the interior portions of the air bag, usually by sewing, welding, gluing, or other joining techniques.

15 **FIG. 1** shows a side view of an air bag **10**. Air bag **10** is comprised of a front bag panel **4** and a rear bag panel **6**, bag panels **4** and **6** being substantially circular, although other panel geometries could also be used. For example only, and not meant as limitation, bag panels **4** and **6** having the shape of a regular *n*-sided polygon could also be used.

20 As is standard within the industry for this type of simple air bag, bag panels **4** and **6** should have the same geometry.

25 **FIG. 2** shows a cross-sectional view of air bag **10**, revealing the arrangement of a tether system therein. Tether segments **14** (shown in **FIG. 3A** as being cut in substantial alignment with the warp or fill of a fabric blank) are attached to front bag panel **4** and rear bag panel **6**. The end of each tether segment **14** that is attached to a bag panel (**4** or **6**)

shall be known as the bag-attachment end. Tether segments **14** are shown in lapped fashion with one another in the interior of air bag **10**. The end of each tether segment **14** that is attached to another tether segment **14** shall be known as the tether-attachment end. The joining of tether segments **14** (at their respective tether-attachment ends) is shown as being achieved by means of seam **18**, but such joining may be accomplished by any other means, such as welding, gluing, or other attachment techniques. In one embodiment, tether segments **14** are substantially rectangular in shape, although any segments having a greater length than width may be used, including tether segments **14** with flared or arc-shaped bag-attachment ends.

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In one embodiment, at least one central region reinforcement **12** (shown in **FIG. 3B**) is also attached to front bag panel **4**, as well as rear bag panel **6**. It is common for reinforcements, having a circular or other shape, to be used in the production of air bags **10**. One or more central region reinforcements **12** are included with tether segments **14** to form tether panel **24** (as shown in **Fig. 3C**). Such reinforcements **12** are particularly important in preventing tears around the mouth of air bag **10**, at the location of the inflation media. For that reason, up to five reinforcements **12** may be desirable for attachment to rear bag panel **6**. In other circumstances, such as when cool-temperature inflation media are used, no reinforcements **12** may be needed.

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Tether segment **14** is part of a multi-segment tether panel **24** that is shown in **FIG. 3C**. In one embodiment, tether panel **24** is comprised of at least two of tether segments **14** and at least one central region reinforcement **12**. Central region reinforcement **12** is positioned in the central attachment region of bag panel **4**. Tether segments **14** are positioned radially about the central attachment region of bag panel **4** and are secured at their respective bag-attachment ends to reinforcement **12** and to bag panel **4** by seam

22, as indicated by a dotted line in **FIG. 3C**. Similarly, tether segments 14 and reinforcement 12 are attached to rear bag panel 6. The tether-attachment ends of tether segments 14 attached to front bag panel 4 are joined to the tether-attachment ends of tether segments 14 that are attached to rear bag panel 6 by seaming, welding, gluing, or 5 other attachment means as are known in the art.

FIG. 3D shows a variation of tether panel 24. In this embodiment, central region reinforcement 12 is omitted. Tether segments 14 are positioned radially about the central attachment region of bag panel 4 or 6 and are then attached to bag panel 4 or 6 10 by means of seam 22. As described previously, other attachment means including welding or gluing could also be employed. In this embodiment, although tether segments 14 do not directly contact one another, tether segments 14 nevertheless act in cooperation with one another and with bag panel 4 or 6 to which they are attached (not shown) to form tether panel 28.

15 Turning now to **FIG. 4**, a three-legged tether panel 34 is shown. Three-legged tether panel 34 is comprised of three tether segments 14 and at least one central region reinforcement 12 that is positioned in the central attachment region of bag panel 4 or 6. Tether segments 14 are positioned radially about the central attachment region of bag 20 panel 4 or 6 and are secured at their respective bag-attachment ends to reinforcement 12 and to bag panel 4 or 6 by seam 22. Three-legged tether panels 34 are useful for reducing bag oscillation during deployment.

25 **FIG. 5** shows a four-legged tether panel 44. Four-legged tether panel 44 is comprised of at least one central region reinforcement 12 that is positioned in the central attachment region of bag panel 4 or 6 and four tether segments 14 positioned radially about the

central attachment region of bag panel **4** or **6**. Seam **22** secures tether segments **14** and reinforcement **12** to bag panel **4** or **6**, although other attachment means could also be used. Four-legged tether panels **44** are even more capable of reducing oscillation during bag deployment.

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FIG. 6 illustrates an arrangement on a fabric blank **90** of air bag panels **4** and **6**, tether segments **14**, and central region reinforcements **12**. By way of example only, bag panels **4**, **6** having a circular shape are illustrated. The separation of the conventional tether into multiple tether segments **14** allows a greater number of air bag components to be produced from a smaller length of fabric, by nesting tether segments **14** between bag panels **4**, **6** into areas that would otherwise be considered fabric waste. Further, because the tether panels **14** are cut in substantial alignment with the warp or fill of fabric blank **90**, the amount of fabric utilized per finished air bag **10** and the amount of fabric waste is decreased significantly. This statement applies to tether panels **34** and **44** as well.

The multi-segment tether system of the present invention includes a pair of tether panels **24** (or **28**, **34**, or **44**) whose individual tether segments **14** are cut in substantial alignment with the warp or fill of fabric blank **90**. Each tether panel **24** is comprised of multiple tether segments **14** and may or may not include central region reinforcements **12**. By incorporating these various multi-segment tether systems, the present invention addresses the issues of fabric utilization and cost, thus representing a useful advancement over the prior art.